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DAB User's Guide

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SECTION 1.0 SUMMARY

The Display AButments (DAB) program is a graphics system for displaying PAN AIR geometries. It can be used to label geometry components, such as abutments, networks, and network edges. In addition, DAB can create a file identifying possible errors in a PAN AIR abutment list. A separate system (MAKADF) has been developed to format abutment list information returned from PAN AIR into the Abutment Definition File format required for input to DAB. DAB can help to alleviate the very time-consuming and error prone "abutment list checking" phase of developing a valid PAN AIR geometry. It can also be used to examine details of the geometry definition before PAN AIR is used. DAB therefore represents a valuable tool for debugging complex PAN AIR geometry definitions.

DAB is written in FORTRAN 77 and runs on a Digital Equipment Corporation VAX-11/780 under VMS. It utilizes a special "color" version of the SKETCH hidden line analysis routine developed by David Hedgley (NASA Ames-Dryden) and the ASP graphics package, which creates a standard Device Independent Plot (DIP) file. DAB was developed for the PAN AIR user community within the Advanced Aerodynamics Concepts Branch of NASA Ames Research Center by staff from the Palo Alto office of Informatics General Corporation under Contract #NAS2-11555-306-1.

SECTION 2.0 INTRODUCTION

DAB is a graphics system for plotting PAN AIR geometries. Display options include labeling networks, network edges, and PAN AIR abutments with appropriate identifiers. DAB can also display individual panels of each network in dashed line type. Network edges are drawn as solid lines; abutments are drawn as doubly-thick solid lines. For cases where there is no Abutment Definition File (ADF) specifed in the user's Control File, DAB can reflect the PAN AIR half-configuration geometry about the XZ plane (to display the full configuration) and/or automatically eliminate wake networks from the display.

DAB allows user-specification of plot titles, geometry features to be labeled, viewing angle, and plot limits for zooming into regions of the geometry which are of particular interest. Labels created for the various geometry components are of the following form:

LABEL	DESCRIPTION
N ***	Network ***
E *	Edge *
A ***	Abutment ***
ESA****	Empty-space abutment ****
PSA****	Plane of symmetry abutment ****

Labels for abutments and network edges are rotated so that they are printed parallel to the line segment being labeled. In cases where the PAN AIR half-configuration geometry is reflected, network numbers for reflected networks are offset by the number of networks processed in the original half-model.

The user can optimize the efficiency of runs by grouping requests for the same view angle in the DAB Control File. DAB recognizes consecutive identical view angle requests and does not go through the time-consuming hidden line analysis unless a different angle (roll, pitch, yaw) has been specified in the Control File.

There are several error conditions which are possible within the DAB program. Most of these involve input PAN AIR geometry files which contain too much data for the program to handle. When such a situation is recognized, the user is so advised and the program terminates.

SECTION 3 ENVIRONMENT (NASA Ames Research Center)

The DAB program is written in FORTRAN and runs on a Digital Equipment Corporation VAX 11/780 under VMS. It is currently available on the FAE VAX node at NASA Ames Research Center and can be invoked FAE::FACO:[PANAIR.DAB]DAB. It may be necessary to increase the VAX VMS system parameter PGFLQUOTA for the account from which DAB is to be run (because of the large arrays needed by this program). A PGFLQUOTA of 80000 has proven to be satisfactory for current users, who are dealing with PAN AIR geometries having up to 30000 panels and 200 networks (for full configurations).

DAB is used in conjunction with the PAN AIR and MAKADF programs. MAKADF is a FORTRAN program which runs on the VAX and which creates an ADF from abutment list information provided in PAN AIR output files. MAKADF prompts for the name of the PAN AIR output file containing the abutment list.

A standard scenario for using DAB follows:

- o A PAN AIR geometry file is created.
- o If abutments are to be investigated:
  the geometry is submitted to PAN AIR so that an abutment list is generated. MAKADF is run to format the abutment list into the ADF format.
- o A DAB Control File (shown in Appendix A) is created to specify the plots which are desired.
- o DAB is run to create a Device Independent Plot (DIP) file.
- o Plots are created using one of the many DIP file processors available at Ames (e.g. DIPQMS, DIPTEK, DIPVER, DIPVRC).

Because of the CPU time requirements for the hidden line analysis, it is often appropriate to run DAB in BATCH mode. CPU times to generate plot frames vary, of course, with the complexity (i.e. number of networks, panels, abutments) of the PAN AIR model. For reference, the F16 geometry shown in Appendix C contains nearly 11000 panels; there was no Abutment Definition File available for this geometry. Creating the DIP file for the two F16 plots shown required approximately 25 minutes of CPU time on the VAX. If no ADF is specified in the Control File and reflection (symmetry) is requested, the number of networks and panels double. Processing time on the VAX increases similarly.

Tailoring dimensions in the DAB program to handle specific (large) geometry combinations is readily accomplished by modifying quantities declared in PARAMETER statements in the DAB driver (and recompiling and relinking). Dimensions required to handle large PAN AIR geometries may require certain VAX VMS system parameters, (e.g. PGFLQUOTA and Virtual Page Count) to be increased to allow linking and running of programs with large memory requirements.

SECTION 4 INPUT REQUIREMENTS

DAB requires two input files - a DAB Control File and a PAN AIR geometry file. An Abutment Definition File may also be supplied.

The DAB Control File contains the name of the PAN AIR geometry file to be processed, the name of the Abutment Definition File (if desired), quantities which control display of wake networks and geometry reflection to create and display a full configuration, and the view angles and plot options to be used to generate desired plots. The structure of the DAB Control File is straightforward and is shown in Appendix A.

The PAN AIR geometry file contains the PAN AIR networks which are to be displayed. The structure of this file is not presented here, but is discussed in PAN AIR documentation. If wake networks are to be ommitted from plots, then EACH wake network in the PAN AIR geometry file must be followed by a "BOUNDARY CONDITION=" record. For DAB, a valid wake network must be a class 1, subclass 4 (or 5) network (e.g. BOUNDARY CONDITION= 1 4).

The optional Abutment Definition File (ADF) lists the PAN AIR-defined abutments in terms of network numbers and starting and ending indices along the edges of networks. The structure of the ADF is shown in Appendix B. An ADF can be created (with substantial effort) using an editor, or, more simply, by running the MAKADF program, which reads in the abutment list created by the PAN AIR DQG module and reformats the information into the specified ADF format.

SECTION 5 OUTPUTS

DAB creates a standard Device Independent Plot (DIP) file. Plots of DIP files can be created using any of several DIP file processing utilities available at Ames, such as DIPQMS, DIPVER, DIPD48, DIPVRC, and DIPTEK. The plots shown in Appendix C were created on a QMS laser printer using DIPQMS.

If an Abutment Definition File is specified in the Control File, DAB creates an Abutment Error Checking File which contains statistics (starting points, end points, and midpoints) for all abutments and which identifies POSSIBLE problem areas in the abutment definitions, such as two definitions of a single abutment which proceed in opposite directions. It is emphasized that the abutment errors reported in this file may be unjustified in certain cases, due to the considerable flexibility provided by PAN AIR for defining networks. The name of the Abutment Error Checking

File is derived from the name of the input Abutment Definition File with a filename extension of ".ERR".

SECTION 6 DISCUSSION OF METHOD

DAB uses the SKETCH hidden line analysis algorithm developed by David Hedgley (reference 1) to determine which elements of the PAN AIR model are visible in the user-specified view. The version of SKETCH being used includes a color feature which is not available in general releases. DAB relies heavily upon the color capability to identify the type of picture element (e.g. network center or abutment segment) being returned after the hidden line/surface analysis has been performed.

The basic criteria used to determine if a plot element should be labeled (if requested in the Control File) are:

1) The center of the network containing the feature is "visible"
2) Enough room exists to label the feature.

DAB passes a short line segment at the center of each network (and normal to the panel containing the network center) to the hidden line analysis routine. If any part of that segment is determined to be visible, the network center is considered visible and labels for network center, edges, and abutments are enabled if requested. The algorithm implemented is not 100% foolproof. PAN AIR geometry panels may violate the planar polygon requirement of the SKETCH hidden line/surface analysis software. Because of this, DAB will occasionally fail to label elements of a picture for a visible network which should be labeled. In addition, the short segment at the center of a hidden network may "pierce" the network which exists on the far side of the geometry so that labels appear for a network which is not really visible.

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1) David Hedgley's SKETCH is a solution to the classic hidden line problem in computer graphics. Relevant literature includes:

A General Solution to the Hidden-Line Problem
NASA Reference Publication 1085

User's Guide for SKETCH
NASA Technical Memorandum 81369

Coincident geometries are also a problem. DAB passes network edge segments to the hidden line analysis software many times. The result is that a given segment may be determined to be visible as a panel edge, but not as a network edge or as a segment of an abutment. There are therefore occasionally "random holes" in some line types on plots.

APPENDIX A DAB CONTROL FILE

Initial records in the Control File contain the names of the PAN AIR geometry file and of the Abutment Definition File to be used for the current run. As noted, the ADF is optional. If an ADF is not available or is not to be used, the corresponding record in the Control File should be blank. If no ADF is specified, the next two records can be used to suppress wake networks from plots and/or to reflect the geometry so that a full configuration is displayed. In the example below, an ADF is specified so that the "NOWAKES" and "SYMMETRY" records which follow are ignored. They must still appear in the Control File.

For each desired plot, the Control File allows the user to specify plot titles, plot options to be activated, the view angle to which the PAN AIR geometry is to be rotated, and the X and Y display limits to be used so that regions of interest can be closely scrutinized.

A sample Control File follows. Descriptions of records are enclosed in angle brackets (‹ ›) for clarification, and are not part of the file. All records must begin in column 1.

```
GEOM.DAT                     ‹Name of PAN AIR input file›
ABUT.DAT                     ‹Name of Abutment Definition File›
NOWAKES                      ‹Causes wake networks to be ommitted›
SYMMETRY                     ‹Causes geometry to be reflected›
Plot number 1                ‹Title 1:  up to 80 characters›
networks and edges           ‹Title 2:  up to 80 characters
en                           ‹Plot options E and N selected...see below
155. 40. 220.                ‹Roll, pitch, yaw...see below›
-10. 500. 6300. 6800.        ‹Xmin, xmax, ymin, ymax.. see below›
Plot number 2                ‹Title 1 for second plot, etc.›
     .                                  .
     .                                  .
     .                                  .
```

The following briefly describes the control quantities which must be provided in the Control File.

NOWAKES

This option is only valid when the ADF record in the Control File is blank. When an "N" or "n" appears in column 1 of this record, DAB ignores wake networks in the PAN AIR geometry file. (Valid wake networks for DAB have class 1, subclass 4 (or 5) boundary conditions.) When this option is used, EACH wake network in the PAN AIR geometry must be followed by a "BOUNDARY CONDITION=" record, which must appear before the start of the next network definition.

SYMMETRY

This option, also, is only valid when the ADF record in the Control File is blank. When an "S" or "s" appears in column 1 of this record, DAB reflects all networks in the PAN AIR geometry file about the XZ plane. This allows display of both halves of the model geometry. It DOUBLES the number of networks and panels to be processed. The NOWAKES option may be used in conjunction with the SYMMETRY option.

PLOT OPTIONS

Select any combination (in any order) of P, A, N, E, G (lower case equivalents also allowed) to request desired plot and labeling functions as follows:

OPTION	DESCRIPTION
P (or p)	Draw panel boundaries in dashed line type.
A (or a)	Label abutments.
N (or n)	Label networks.
E (or e)	Label network edges.
G (or g)	Draw scaled axes (grid) around plot area. This option is very useful for identifying appropriate axis limits to be used when zooming in on a particular area of the geometry is desired.

This record must begin in column 1 and must not contain embedded blanks. If the plot options record is blank, the corresponding plot will show unlabeled network edges only.

ROLL, PITCH, and YAW

The viewing angle must be specified in degrees. The order in which the body-axis-centered rotations are performed is: 1) roll 2) pitch 3) yaw.

XMIN, XMAX, YMIN, and YMAX

These values represent axes limits for the plot area, and are not necessarily related to coordinates in the reference axis system. A standard plot format is used, with X increasing to the right and Y increasing up the page.

By requesting a plot with XMIN, XMAX, YMIN, and YMAX values which define the rectangular region of interest, a user can zoom in on a specific region on the model surface. This magnification feature is also extremely useful to eliminate crowded (sometimes illegible) labels. DAB may adjust these plot limits to maintain geometry proportions on plots. If the user wishes to see the entire PAN AIR model definition, a self-scaled view may be created by specifying 0.0 for all four plot axes limits. For a given view angle, it is usually

necessary to request such a self-scaled plot to identify exactly where the rotated coordinates of the model lie so that subsequent plot requests can zoom into portions of the model which are of particular interest. (Note: Rotated coordinates of a given geometry may differ for the WAKES and NOWAKES cases due to the use of different centers of rotations for these two situations.)

Axes limits are displayed at the top of each plot for reference. In addition, by using the "G" plot option, graduations on each axis are labeled to help the user determine coordinates which define the region of interest.

APPENDIX B ABUTMENT DEFINITION FILE

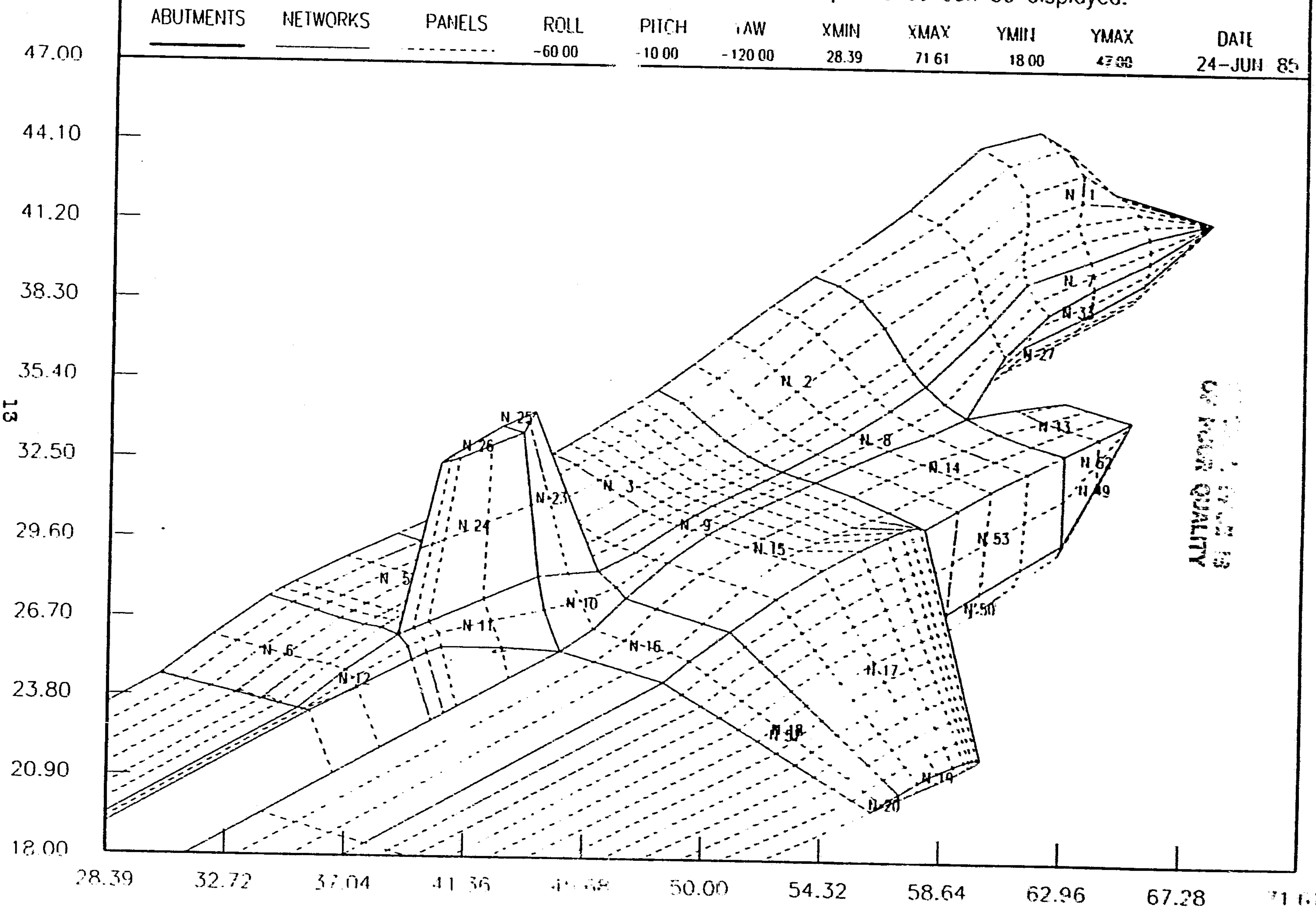
Abutment Definition Files (ADFs) contain PAN AIR-defined abutment information, such as network number and indices for the starting and ending points of the abutment for the current network. Network names are included for reference only. ADFs are most readily created by running the MAKADF program on the FAE VAX (FAE::FACO:[PANAIR.DAB]MAKADF). MAKADF reformats PAN AIR abutment list output into the ADF structure shown below.

The following is excerpted from a valid ADF. Descriptions are provided in angle brackets (‹ ›) and are not part of the file.

```
109         ‹# of abutments›
1     2     ‹Abut #, # of networks in the abut.  For each network:
19    4   21    1   WING-UPR   ‹network #, edge #, begin, end, name›
17    3   17    3   EJC-UPR    ‹next network #, etc.›
2     2                        ‹Next abutment #, etc.›
20    4   21    1   WING-LWR
18    1   17    1   EJC-LWR
...
...
...
2010      2                    ‹Plane of symmetry abutment›
 1    1    1    4   NOSE-1
-1    0    0    0   PLN OF SYMMETRY
...
...
...
1001      1                    ‹Empty space abutment
39    3    5    1   NOZ-WAKE-UPR-39
```

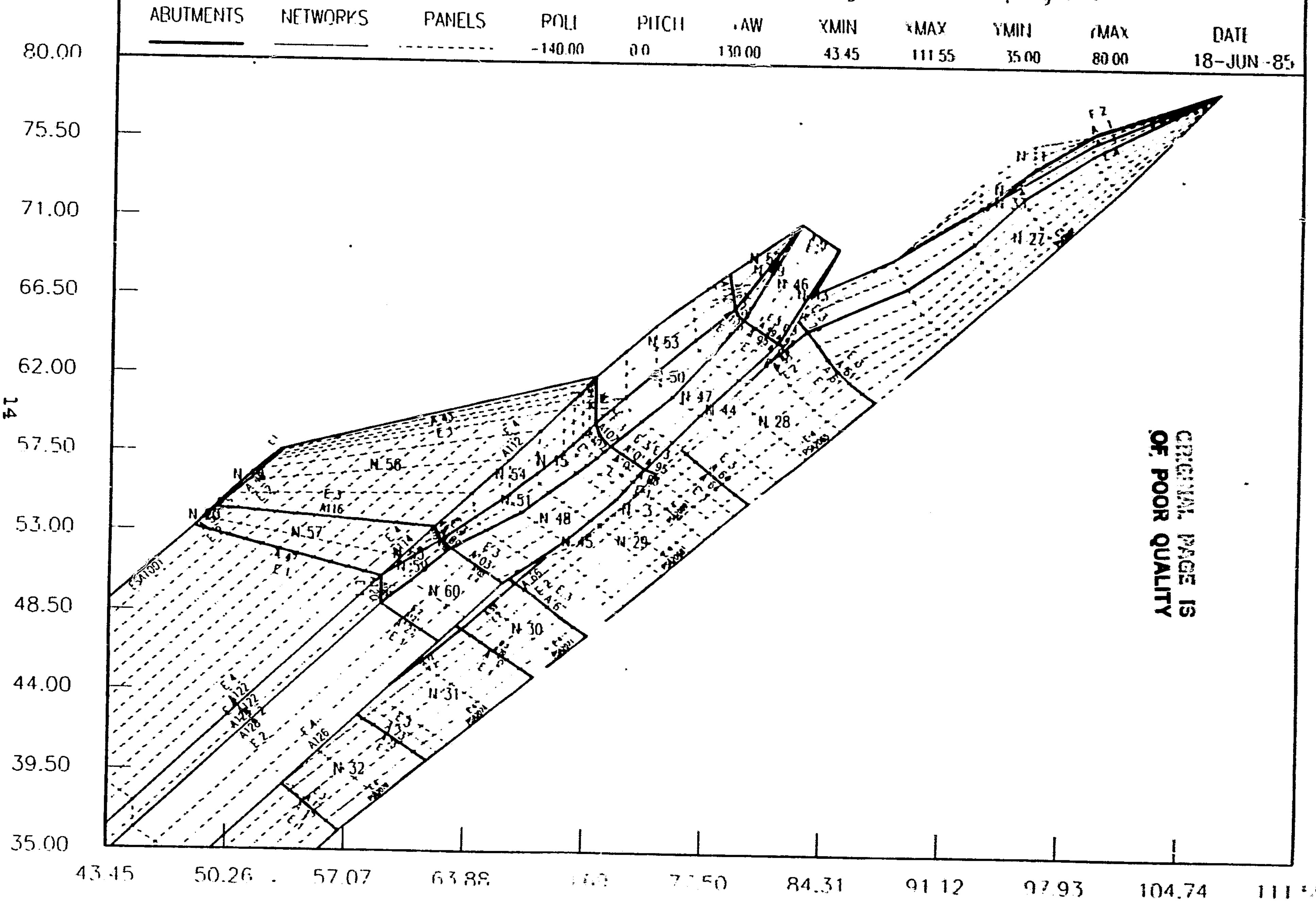
APPENDIX C SAMPLE PLOTS

The following pages contain plots created by the DAB program. DIPQMS was used to plot the resulting DIP files on a QMS laser printer.

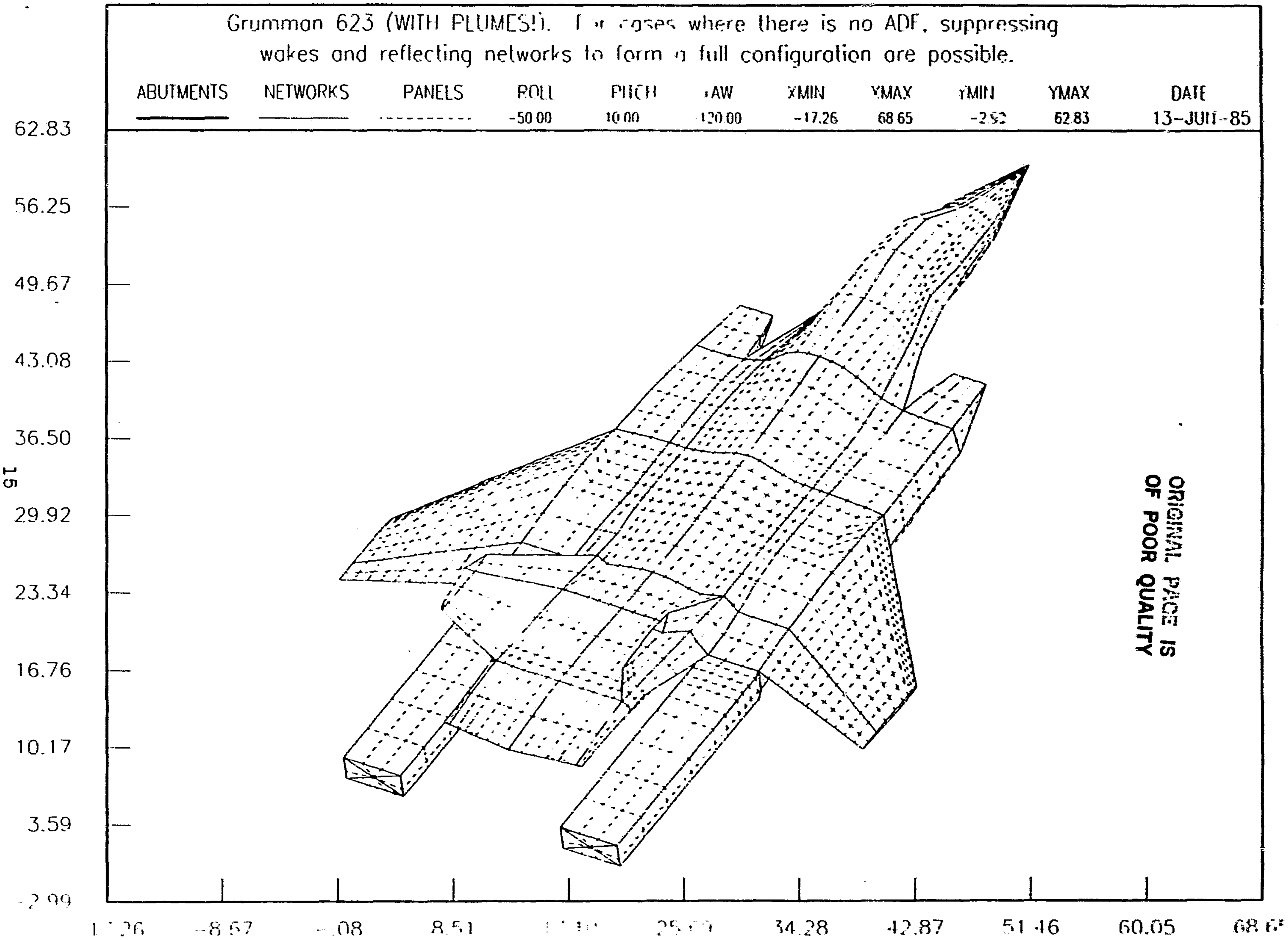


Grumman 623. DAB can be used to display individual panels of each network as dashed lines. Networks can be labeled and scaled plot axes can be displayed.

Grumman 623. Abutments and edges may also be identified with appropriate labels. Abutment Definition Files can be created using the MAKADF program.

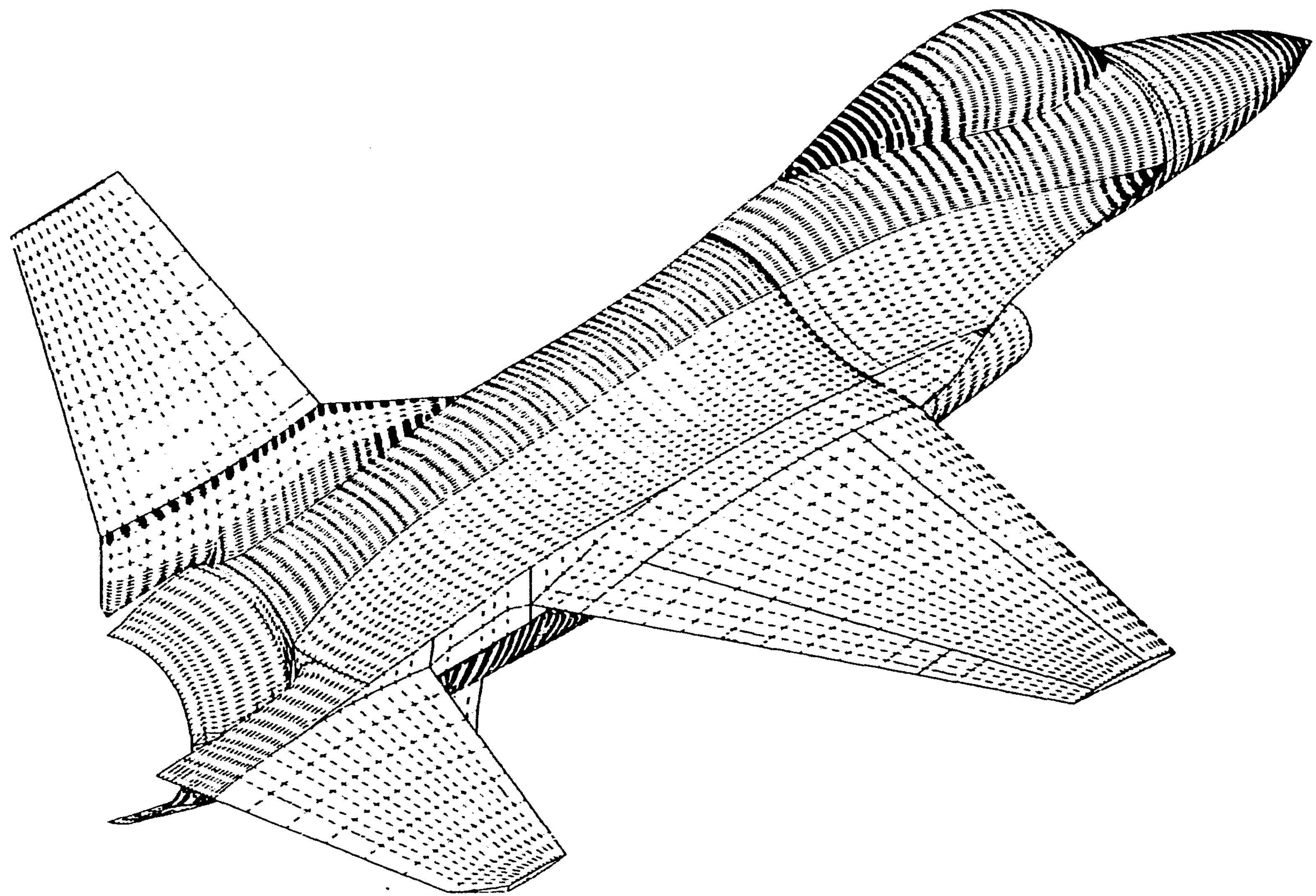


ORIGINAL PAGE IS OF POOR QUALITY


Grumman 623 (WITH PLUMES!). For cases where there is no ADF, suppressing
wakes and reflecting networks to form a full configuration are possible.
ABUTMENTS
NETWORKS
PANELS
ROLL
-50.00
PITCH
10.00
-120.00
XMIN
-17.26
XMAX
68.65
YMIN
YMAX
62.83
DATE
13-JUN-85
62.83
56.25
49.67
43.08
36.50
29.92
23.34
16.76
10.17
3.59
-8.67
8.51
34.28
42.87
51.46
60.05

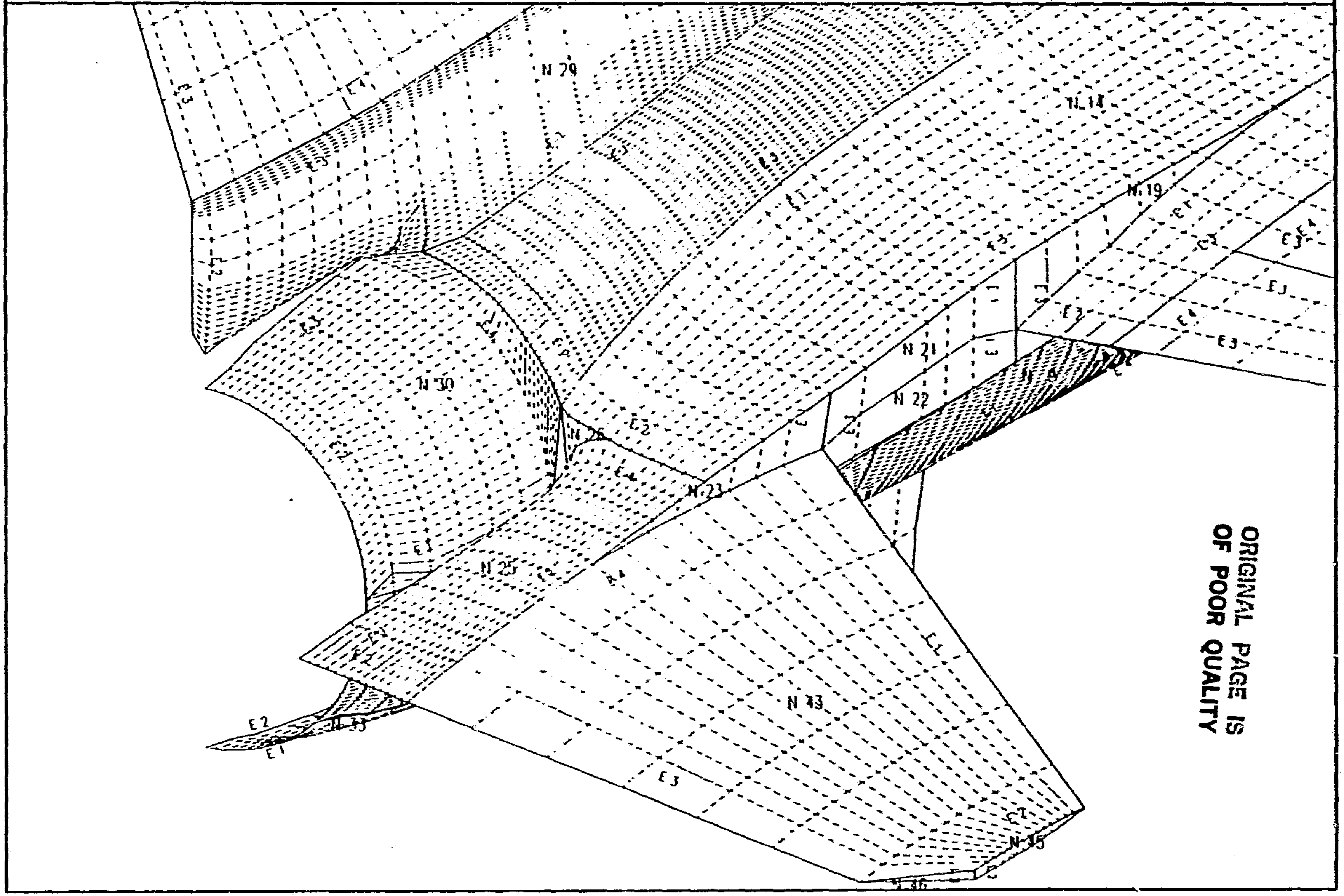
Array dimensions in DAB can be adjusted readily to handle specific needs of large PAN AIR geometries. This F16 half model contains nearly 11000 panels.

ABUTMENTS	NETWORKS	PANELS	ROLL	PITCH	YAW	XMIN	XMAX	YMIN	YMAX	DATE
———	———	- - - - - - - - -	-70.00	0.0	120.00	-18.01	305.53	-9.60	201.58	14-JUN-89



By specifying appropriate XMIN, XMAX, YMIN, and YMAX values, DAB can be made to "zoom" into regions of the geometry which are of particular interest.

ABUTMENTS	NETWORKS	PANELS	ROLL	PITCH	YAW	XMIN	XMAX	YMIN	YMAX	DATE
			-70.00	0.0	-120.00	-1.64	151.64	0.0	100.00	14-JUN-85



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15. Supplementary Notes

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16. Abstract

Use of the Display AButments (DAB) program which plots PAN AIR geometries is presented. The DAB program creates hidden line displays of PAN AIR geometries and labels specified geometry components, such as abutments, networks, and network edges. It can be used to alleviate the very time-consuming and error prone "abutment list checking" phase of developing a valid PAN AIR geometry, and therefore represents a valuable tool for debugging complex PAN AIR geometry definitions.

DAB is written in FORTRAN 77 and runs on a Digital Equipment Corporation VAX-11/780 under VMS. It utilizes a special color version of the SKETCH hidden line analysis routine developed by David Hedgley and the ASP graphics package, which creates a standard Device Independent Plot (DIP) file. DAB was developed for the PAN AIR user community within the Advanced Aerodynamic Concepts Branch of NASA Ames Research Center by staff from the Palo Alto office of Informatics General Corporation.

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